

III. Conservation of Biological Diversity

Massachusetts has a rich diversity of natural resources. Throughout the state, however, biodiversity is being threatened by the destruction and fragmentation of habitat (NHESP, 2001). Several state initiatives are attempting to combat this trend. Chief among these are the efforts of EOEAs, private conservation organizations, and local governments to identify and protect important open space.

Protected Open Space and Land Conservation

As of November 2004, approximately 25% (approximately 285,000 acres) of the 5 Berkshire Ecoregions are considered “permanently protected open space” (Figure 8). About 89% (254,000+ acres) of this is permanently protected through Fee ownership and 11% (~30,000 acres) through Conservation Restrictions / Easements. Most of the protected open space held in Fee is state-owned (63% / ~180,000 acres), with lesser amounts owned by local governments (17% / ~47,000 acres), non-governmental organizations (7% / ~19,000 acres) and the federal government (0.7% / ~8,000 acres). Ownership of protected lands is summarized in **Table 5** and depicted in **Figure 8** below. Additional information on permanently protected open space in the Berkshire Ecoregions and Land Type Associations is provided in **Appendix III**.

Table 5. Protected open space¹ in the Berkshire Ecoregions.

Type	Acres Protected Land	% Ecoregions	% Protected Land
Permanent	254,263	22%	89%
Federal	8,444	0.7%	3%
<u>State/DCR</u>			
<i>DCR-State Parks</i>	141,028	12%	50%
<i>DFW</i>	37,763	3%	13%
<i>DCR-State Parks/DFW</i>	1,172	0.1%	0%
Total:	179,963	16%	63%
Municipal	47,130	4%	17%
Non-profits	18,726	2%	7%
Open Space Restrictions	30,417	3%	11%
<u>Conservation Restrictions (CR)</u>			
<i>DCR-State Parks</i>	913	0.1%	0.3%
<i>DFW</i>	9,795	0.9%	3%
<i>DCR-State Parks/DFW</i>	50	0.004%	0.02%
<i>Municipal</i>	1,529	0.1%	0.5%
<i>Non-Profits</i>	5,526	0.5%	1.9%
<i>Federal</i>	-	0%	0%
Total:	17,813	2%	6%
<u>Agricultural Preservation Restriction (APR)</u>			
DFA	12,175	1%	4%
<u>CR/APR</u>			
DCR-State Parks/DFA	208	0.018%	0.07%
DFA/Non-Profit	221	0.019%	0.08%
Totals	284,680	25%	100%

Note:

Source: MassGIS / DCR

- All properties were attributed a unique ID related to ownership type (entity and temp or perm) to enable acreage calculations without double-counting.
- Where a property had different entities in the 'Fee Owner' and 'Other Interest' fields, assignments were made as follows: State or Federal agencies took priority, followed by Municipalities, followed by Non-profit agencies.

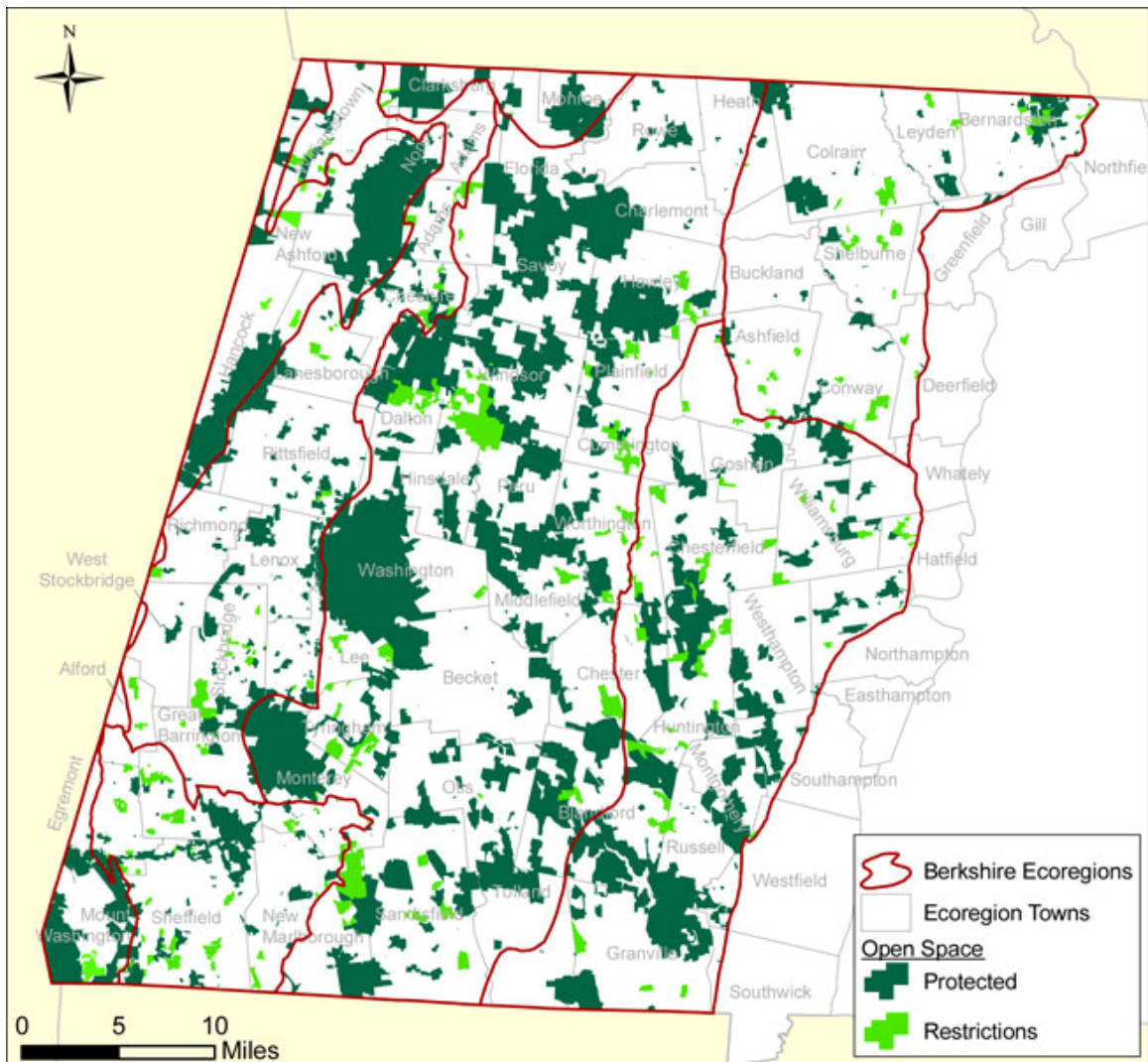


Figure 8. Permanently protected open space in the Berkshire Ecoregions.

The Statewide Land Conservation Plan (SLCP) identifies an additional 340,509 acres of land within the Berkshire Ecoregions (**Table 6**) that are considered important for protection of biodiversity conservation.

Table 6. Statewide Land Conservation Plan¹ (important acres for biodiversity conservation)

Ecoregion	Total Acres	SLCP¹ Acres	Percent
Berkshire-Vermont Upland	433,948	122,965	28.34%
Hudson Highlands	304,920	93,907	30.80%
<i>Berkshire Transition Association</i>	229,616	50,085	21.81%
<i>Western New England Marble Valley Association</i>	75,304	43,821	58.19%
Southern Green Mountains	20,500	10,162	49.57%
Southern Vermont Piedmont	138,574	37,514	27.07%
Taconic Mountains	236,068	75,691	32.06%
<i>Taconic Highlands Association</i>	81,519	30,992	38.02%
<i>Western New England Marble Valley Association</i>	154,549	44,699	28.92%
Totals:	1,134,011	434,145	38.28%

The SLCP is a twenty year/one million acre land conservation vision, created in partnership by land trusts and other environmental non-profit organizations, state, federal and regional environmental agencies and municipalities. The Plan is a grassroots “greenprint” to create a connected open space network across the state before the most significant and connected water supply, biodiversity, urban open spaces, working farms and forests and future recreational sites are lost forever. In developing the plan, more than 40 statewide, regional and local natural resource and open space plans were used to map the most critical statewide and regional resources. The implementation of the plan will involve a range of land conservation and planning tools to protect the most critical resources in the state, including those that are most threatened by sprawl and other imminent land use changes. To order a copy of the Statewide Land Conservation Plan from MassGIS go to: www.mass.gov/mgis/themes.htm#SLCP

One of the underlying goals of the SLCP and of EOE’s land conservation strategy in general is the protection of lands considered to be of high importance from a biodiversity conservation standpoint. The BioMap project (NHESP, 2001) (see: www.mass.gov/dfwele/dfw/nhosp/nhbiomap.htm) provided a “greenprint” of biodiversity hotspots in the state – i.e., the most important intact terrestrial and wetland ecosystems that support the state’s diversity of life (NHESP, 2001). The BioMap Core areas are based on known occurrences of rare plants and animals, plus examples of uncommon natural communities in the state. The Berkshire Ecoregions contains significant acreages of both “core” habitats and “supporting natural landscapes” identified by the BioMap project (**Figure 9**). More than 54 % of the Berkshire Ecoregions is classified as core or supporting natural landscape, compared to just over 40% statewide.

The BioMap Core areas are largely a reflection of known occurrences of rare plants and animals, plus examples of uncommon natural communities in the state. The Berkshire Ecoregions contain a number of these habitats. For example, the NHESP program lists 257 known occurrences of rare wetland wildlife species in the Berkshire Ecoregions (**Figure 11**).

More recently, in 2003, the NHESP released “Living Waters”, an aquatic complement to BioMap to promote the strategic protection of freshwater biodiversity in the state (see: www.state.ma.us/dfwele/dfw/nhosp/nhaqua.htm). That effort identified more than 7,590 acres (0.7%) in the Berkshire Ecoregions as “Core Habitats” (i.e., the lakes, ponds, rivers and streams that are important for the protection of freshwater biodiversity), along with an additional 554,069 acres of “Critical Supporting Watersheds” (CSW, i.e., areas with the highest potential to sustain or degrade Core Habitats) (**Figure 10**). The latter (which includes the core habitat areas) amounts to approximately 49% of the Berkshire Ecoregions. In comparison, about 30.2% of the state as a whole is considered to be CSW.

BioMap and Living Waters present a powerful vision of what Massachusetts would look like with full protection of the land that supports most of our biodiversity. To create this vision, some populations of state-listed rare species were deemed more likely to survive over the long-term than others. Regardless of their potential viability, all sites of state-listed species have full legal protection under the Massachusetts Endangered Species Act (M.G.L. c.131A) and its implementing regulations (321 CMR 10.00). Habitat of state-listed wildlife is also protected under the Wetlands Protection Act Regulations (310 CMR 10.37 and 10.59). The Massachusetts Natural Heritage Atlas shows Priority Habitats, which are used for regulation under the Massachusetts Endangered Species Act and Massachusetts Environmental Policy Act (M.G.L. c.30) and Estimated Habitats, which are used for regulation of rare wildlife habitat under the Wetlands Protection Act. For more information on rare species regulations, see the Massachusetts Natural Heritage Atlas, available from the Natural Heritage & Endangered Species Program in book and CD formats.

BioMap and Living Waters are conservation planning tools and do not, in any way, supplant the Estimated and Priority Habitat Maps which have regulatory significance. Unless and until the combined BioMap and Living Waters vision is fully realized, we must continue to protect all populations of our state-listed species and their habitats through environmental regulation.

Additional data on BioMap Core Habitat, BioMap Supporting Natural Landscapes, Living Waters Core Habitat, Living Waters Critical Supporting Watersheds, Priority Habitats, Estimated Habitats of Rare Wetland Wildlife, Certified Vernal Pools, Potential Vernal Pools, and Rare Species Sub-population Density are in **Appendix IV**.

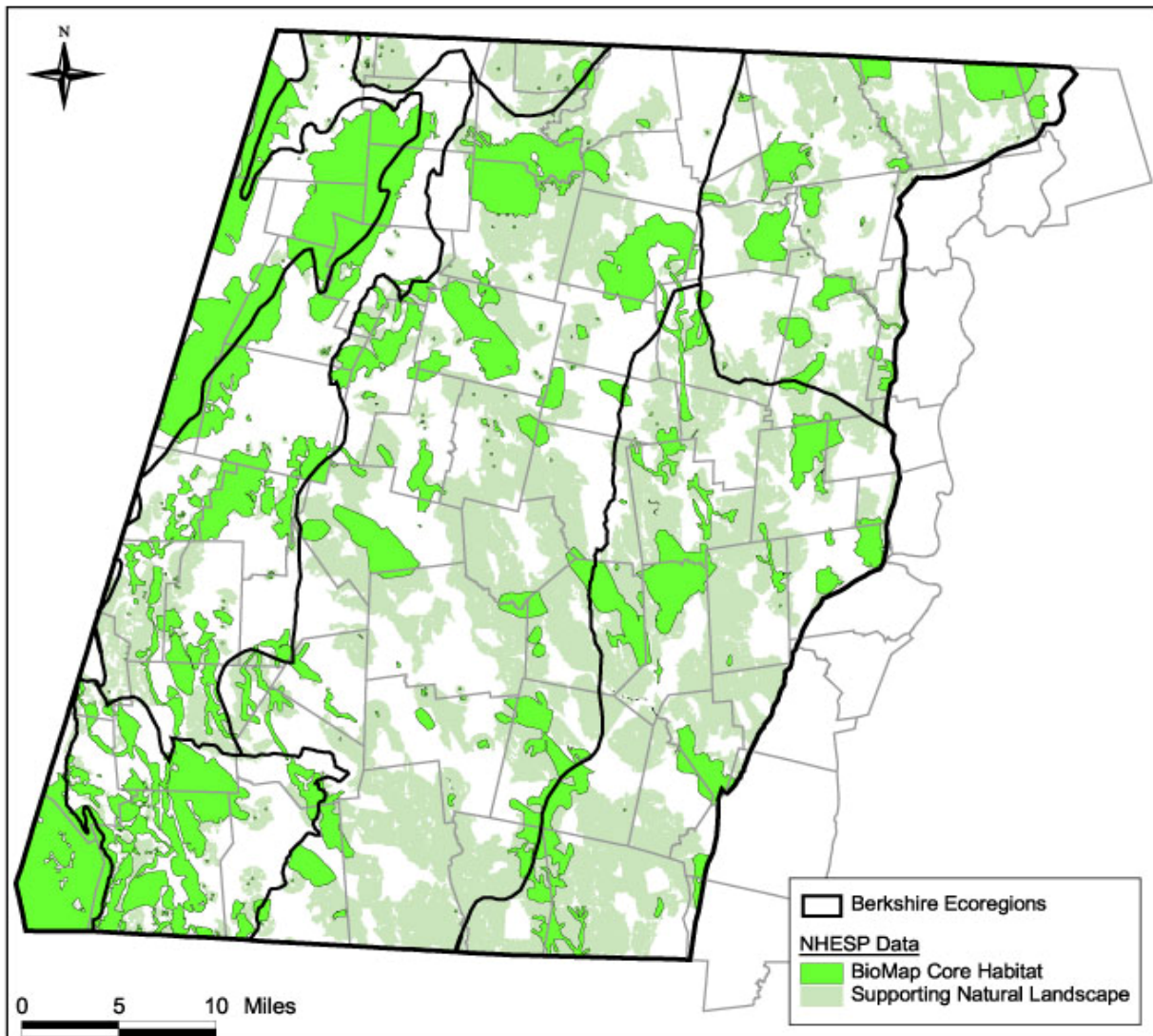


Figure 9. NHESP 2001 “BioMap” core and supporting natural landscape areas in the Berkshire Ecoregions.

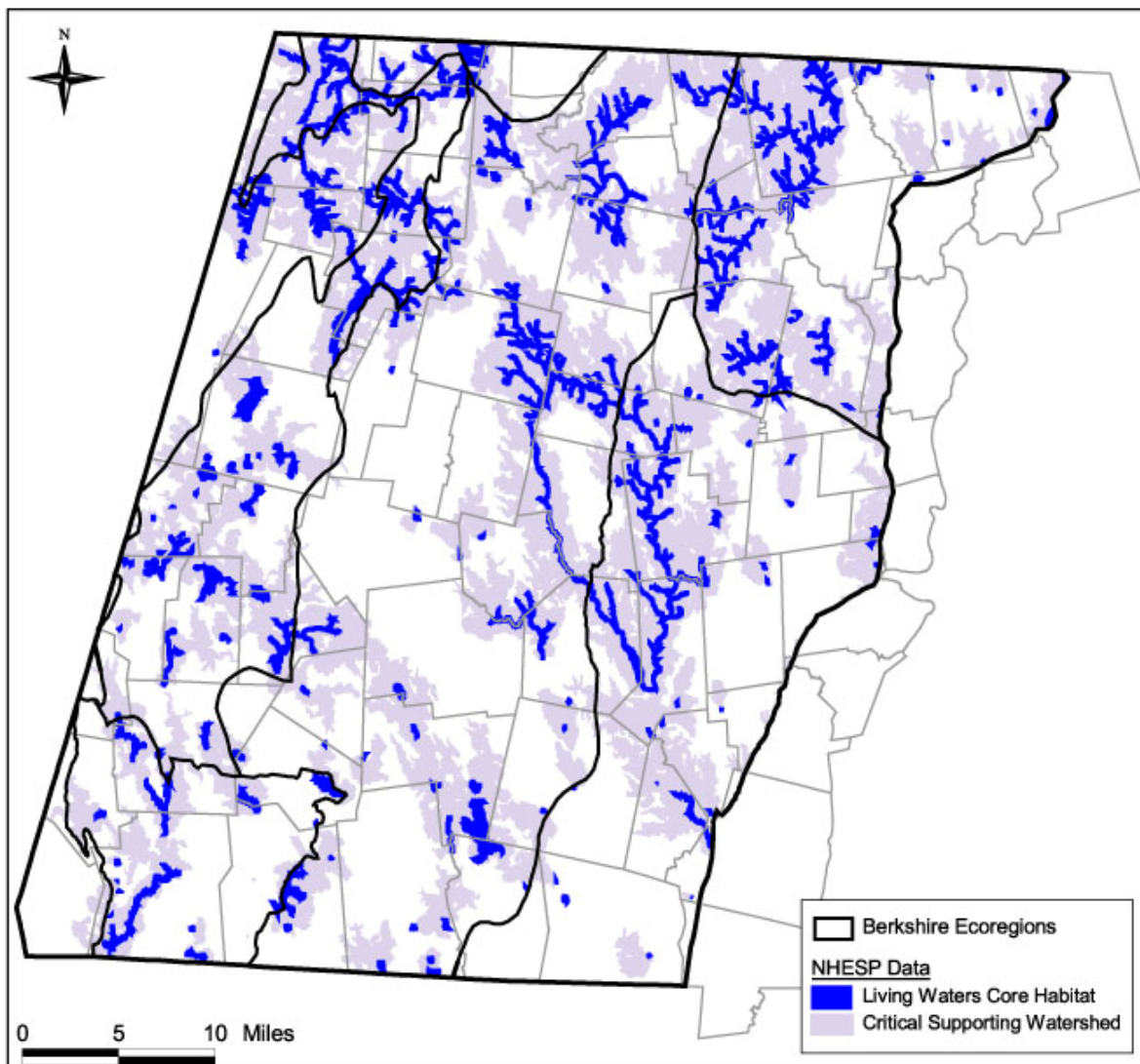


Figure 10. NHESP 2003 “Living Waters” Core Habitat and Critical Supporting Watershed areas in the Berkshire Ecoregions.

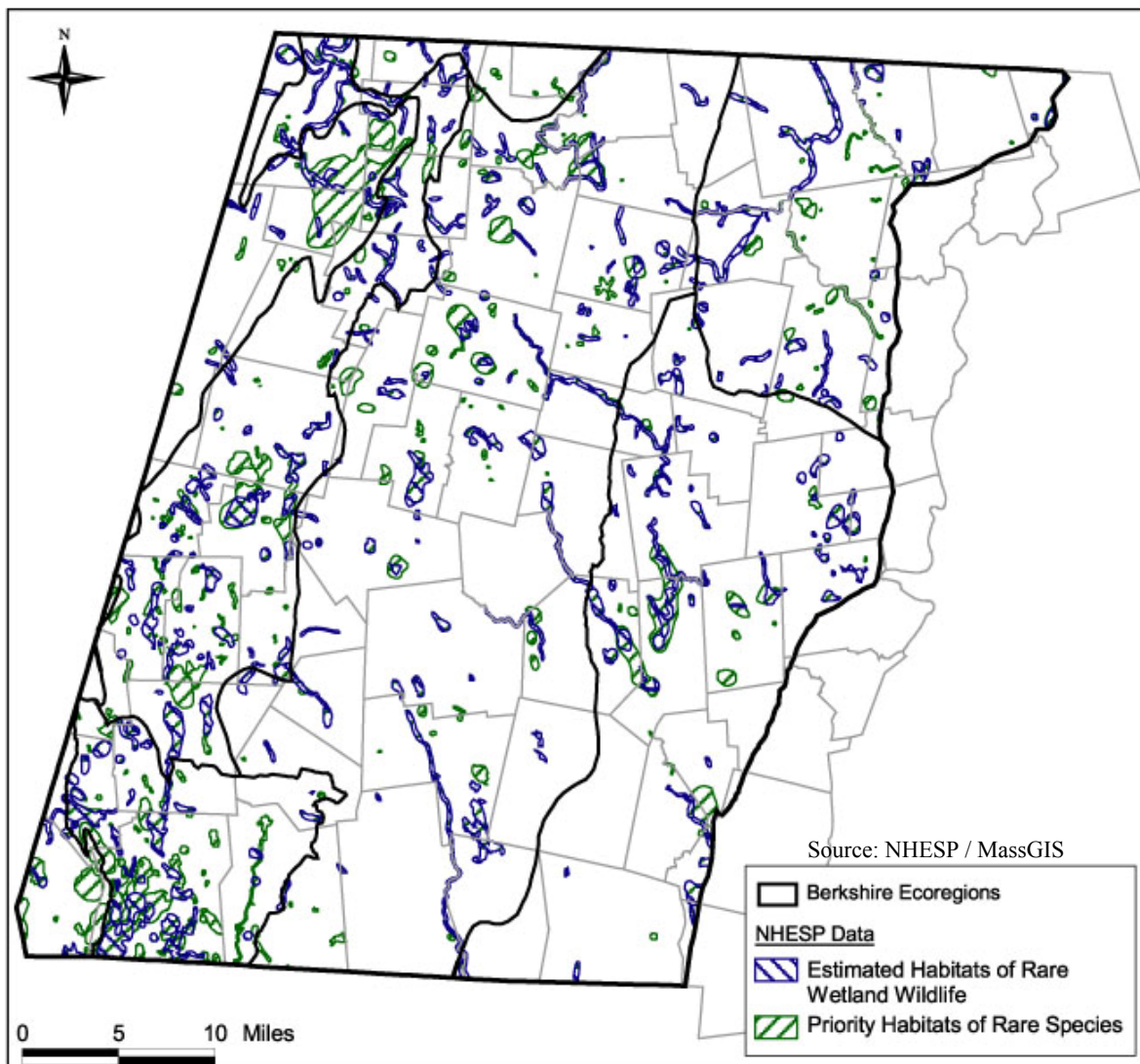


Figure 11. NHESP 2003 “Priority Habitats of State-Listed Rare Species” and “Estimated Habitats of Rare Wetlands Wildlife Species”: July 1, 2003 - *For use with the Wetlands Protection Act Regulations(310 CMR 10)*, in the Berkshire Ecoregions. All Estimated Habitats are also Priority Habitats: they are a subset of Priority Habitats used in the Wetlands Protection Act.

Wildlife Resources in the Berkshire Ecoregions

Dramatic changes in animal species composition have occurred over the past few centuries both in the Berkshire Ecoregions and across the entire Massachusetts landscape. These changes continue today with the resurgence of various bird and mammal species, including black bear, wild turkey, moose, bald eagle, and beaver. Other changes have not been as welcome, including the extinction of the passenger pigeon, the extirpation of species such as the Atlantic salmon, and the on-going declines of various wildlife species associated with grassland, shrubland, and young forest habitats (e.g., Eastern meadowlark, New England cottontail, and ruffed grouse, respectively). Still other species have expanded their natural ranges into Massachusetts, including the Eastern coyote and the cardinal; some, like the coyote, have assumed important roles in wildlife community dynamics (for more information, see www.state.ma.us/dfwele/dfw/dfwcoy.htm). In addition to changes in native animal species, recently introduced or exotic species, such as the mute swan and zebra mussel, have the potential to degrade ecosystems.

These dramatic changes in animal species composition are largely the result of human landuse history from the 1700s to today (see Historical Trends in Forest Composition in Section IV) and unsustainable human consumption of fish & wildlife resources during the eighteenth and nineteenth centuries. An excellent recent summary on this topic is provided in Foster et al. (2002).

Today, fish and wildlife harvest is regulated by the Division of Fisheries and Wildlife, and conservation efforts are in place for rare species through the Division's Natural Heritage program (www.MassWildlife.org). Human landuse, however, continues to impact animal species in the ecoregion as open grassland and shrub habitats continue a century-long decline, and remaining wetlands, riparian habitats, and extensive forest habitats are degraded or fragmented by road infrastructure and other development.

Reclamation and maintenance of some grassland and shrubland habitats is critical for conserving various native wildlife species exhibiting long-term population declines (**Figure 12**). Management of these open habitats is generally most appropriate at the periphery of extensive forestland so that habitat benefits of both open and forested sites are maximized.

At the same time, ecological restoration of degraded habitats is essential to conservation of various state-listed rare species. In particular, forested wetlands in portions of the Berkshires are being degraded by invasive, exotic plants, particularly common buckthorn (*Rhamnus cathartica*) and glossy buckthorn (*Rhamnus frangula*). These aggressive exotic plants displace native species, and can alter the hydrology of wetlands by increasing overall evapotranspiration. This leads to progressively drier site conditions, which can result in the displacement of native species such as the endangered yellow ladies slipper (*Cypripedium parviflorum* Salisb.).

Fire exclusion from the oak forests historically associated with the southern Berkshires (in particular, the Western New England Marble Valley Association of the Hudson Highlands ecoregion, has resulted in the reduction or loss of some woodland grasses and herbs from oak woodlands (e.g., yellow wild indigo [*Baptisia tinctoria*] and wild lupine [*Lupinus perennis* WL]). Wildfires must be controlled so that they do not threaten people and property, but the careful application of prescribed fire under controlled conditions has the potential to enhance regeneration of oak, as well as to reestablish native woodland herbs. The Division of Fisheries and Wildlife's Biodiversity Initiative (www.MassWildlife/dfwele/dfw/bdi/Bdihome.htm) and numerous other public and private conservation organization efforts are attempting to address these issues (see **Appendix V**).

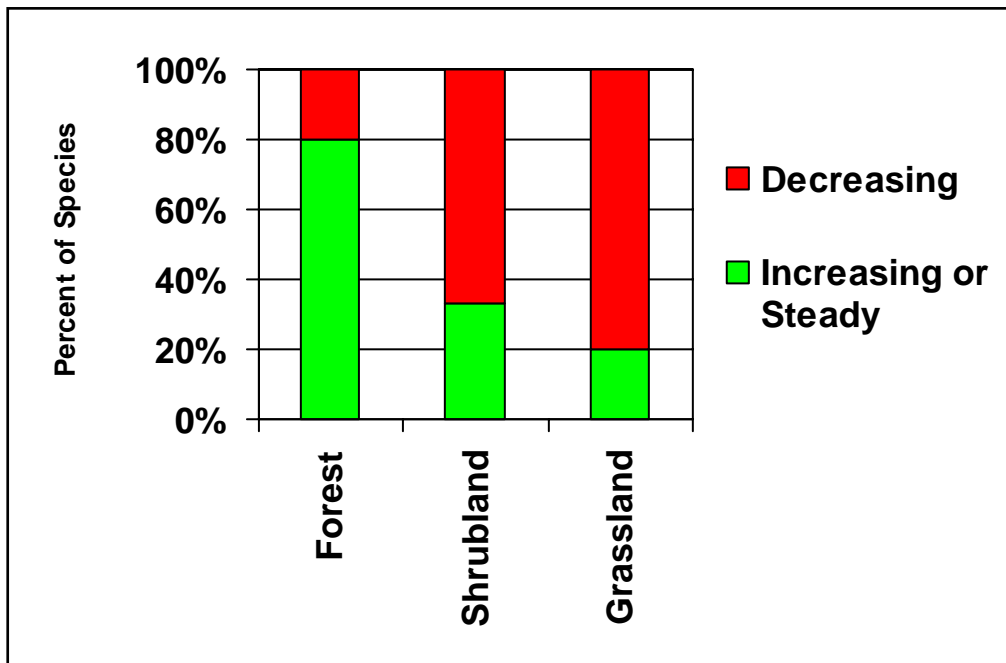
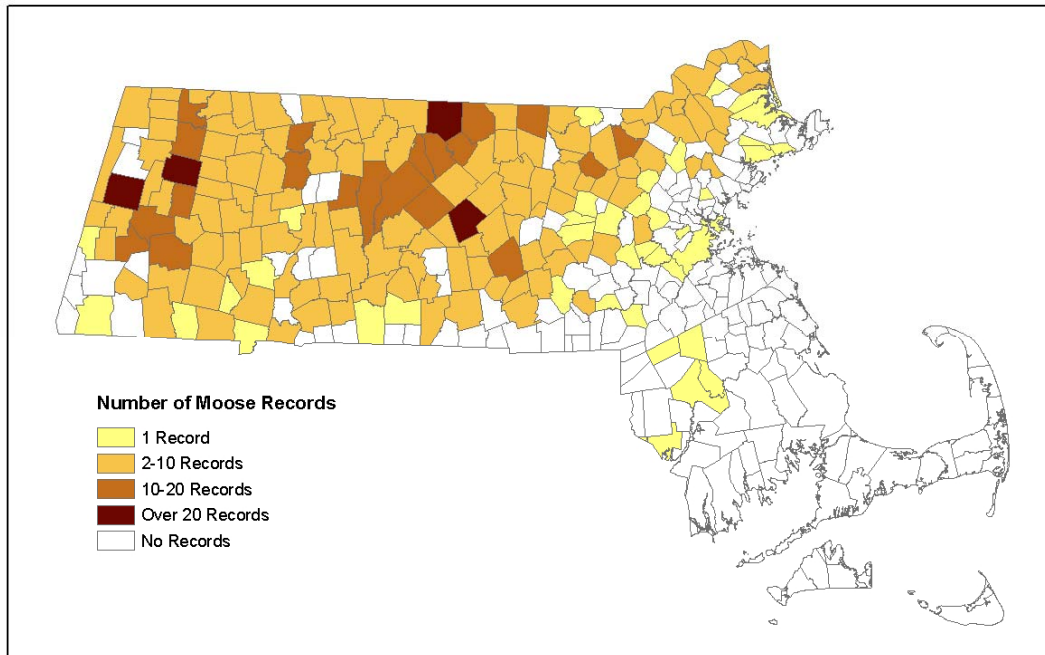


Figure 12. Bird population trends in Southern New England, 1966-2002.
(From the USGS North American Breeding Bird Survey)

The potential for deer and moose browsing to impact native plant species is a concern throughout the Commonwealth. It has been established that densities of >18-20 deer per square mile have detrimental impacts on native plants (Tilghman 1989). DFW currently estimates that deer densities across the Berkshire ecoregions range from 8-12 deer per square mile, but localized exceptions occur, primarily in the southern Berkshires where closures of lands to hunting have led to population densities of >15 deer per square mile. Localized pressure from deer and perhaps moose browsing has been observed on some herbaceous plants (e.g., woodland orchids) in portions of the Berkshire ecoregions, although these impacts may not be wide-spread. The DFW goal in the Berkshire ecoregions is to keep deer densities at <15 per square mile. Any localized impacts of browsing on native plant species may result from a combination of land closures to deer hunting, a lack of woody browse in the predominately sawtimber stage forests of the Berkshires, and the return of moose to the central portion of the Berkshires (**Figure 13**).



Forest resources in the Berkshire Ecoregions provide the bulk of wildlife habitat, and the sustainable management of the region's forests is important in maintaining viable populations of native animal species. Forest conservation issues in the Berkshire Ecoregions affect fish and wildlife resources at two levels. First and foremost, extensive, unfragmented forests must be maintained in the face of burgeoning development (especially in the southern Berkshires) not only to support rural, wood-based economies, but also to sustain viable populations of native animal species (see recent Natural Heritage efforts focusing on terrestrial and aquatic freshwater habitats at www.state.ma.us/dfwele/dfw/nhosp/nhbiomap.htm, and www.state.ma.us/dfwele/dfw/nhosp/nhaqua.htm. Secondly, establishment and maintenance of the full range of forest successional stages is needed to conserve the full complement of animal biodiversity. Biodiversity conservation issues and efforts are summarized in three Natural Heritage publications: *Our Irreplaceable Heritage* (Barbour et al. 1998), *BioMap* (NHESP, 2001), and *Living Waters* (NHESP, 2003).

Fragmentation of extensive forestland limits dispersal of various plant and animal species, and can foster the establishment and spread of invasive exotic species. On average, larger tracts of forest support more species than smaller tracts of similar forest types. The issue of forest fragmentation is further discussed in a following section of this assessment.

While forest cover represents the dominant landuse in Massachusetts today (www.state.ma.us/mgis/landuse_stats.htm), forests in the Berkshire Ecoregions and across the state are generally even-aged (70-90 years) as they recover from both natural and human disturbances including agricultural land abandonment and to a lesser extent of the state the 1938 hurricane. The paucity of both early-seral (<10 years-old) and late-seral (>150 years-old) forest habitat restricts wildlife community diversity. Sustainable management featuring both the harvest of renewable wood products and the establishment of forest reserves can potentially enrich wildlife diversity in the Commonwealth (see, for example, the recent draft of a comprehensive wildlife conservation strategy for Massachusetts at http://www.mass.gov/dfwele/dfw/cwcs/dfw_cwcs.htm.

Potential Impacts on State-listed Rare Species by Forest Cutting Operations

The Department of Conservation & Recreation and the Division of Fisheries & Wildlife consult with the Massachusetts Natural Heritage and Endangered Species Program relative to state-listed rare species and priority natural communities that are known to occur on state lands in the Berkshire Ecoregions. Property managers use this information to mitigate potential negative impacts to these species and communities during the management planning process. As a result, the sustainable harvest of renewable wood products from state lands is fully compatible with the conservation of rare species and communities.

Within the Berkshire Ecoregions, forest cutting near wetlands, vernal pools, and within riparian filters has the greatest potential to impact listed species. Guidelines for timber harvest in the habitats many of these wetland animal species are being developed by NHESP, with the support of DCR and DFW forestry programs. Until these guidelines have been developed, general suggestions include leaving buffers of up to 250m around wetlands. For example, Dragonflies and damselflies (Odonates) of wetlands such as the¹ Ski-tailed Emerald (*Somatochlora elongata*) (SC²), and the damselfly, Tule Bluet (*Enallagma carunculatum*) (SC) need a buffer of natural vegetation for ~250 meters surrounding the wetland. This provides adult habitat for maturation (the adult exoskeletons are very soft when they have just transformed, therefore they need protective vegetation to roost in until they harden), feeding, breeding, and roosting. Other wetland species, including the federally threatened bog turtle (*Clemmys muhlenbergii*) (E²) also need the protected buffers. Species that breed or live in vernal pools, such as the marbled salamander (*Ambystoma opacum*) (T²), and crustaceans such as the intricate fairy shrimp (*Eubranchipus intricatus*) (SC), benefit from retention of mature forest canopy surrounding the pools, keeping them shaded. The salamanders spend their adult lives in the surrounding forest and need buffering from harvesting machinery away from their breeding pools. Riverine species need buffers up and down stream from observation points as well as across the riparian area. For example, riverine dragonflies such as the Rapids Clubtail (*Gomphus quadricolor*)(T) and Riffle Snaketail (*Ophiogomphus carolus*)(T) appear to need from 2.5 to 5 k (depending on habitat continuity) up- and downstream from an observation plus 100 m of natural vegetation on either side of the river/stream for roosting, feeding, breeding, and maturation.

The Berkshire ecoregions, particularly the two Marble Valley Land Type Associations include a variety of types of calcareous habitats that are very unusual. There are a large number of state rare species of plants and animals that occur only to these habitats, particularly the calcareous wetlands. Some of these specialist species do best in undisturbed situations; other plants such as ginseng (*Panax quinquefolius*) (SC) and drooping speargrass (*Poa languida*) (E) are associated with shaded conditions beneath a forest overstory. A few species (several of the state listed moths for example) benefit from disturbance and, with care, are compatible with active forest harvest. Forest cutting practices can occur without negative impacts on many listed species, provided that their occurrence is known to managers and appropriate mitigation is built into the planning process.

Some protected rare plant species such as lyre leaved rock cress (*Arabis lyrata*)(T) and hairy agrimony (*Agrimonia pubescens*)(T) may benefit from some harvesting techniques as these species depend on woodlands with more open canopies resulting from various disturbances such as storms and fires. Many other rare plant and animal species are dependent on different types and frequencies of disturbances reinforcing the need to view forested landscapes as highly dynamic systems.

A list of all natural communities and listed species known to occur within the Berkshire Ecoregions is found in **Appendix VI**. Additional information on natural communities and listed species for individual towns within the ecoregion can be obtained from the Massachusetts Natural Heritage & Endangered Species Program on-line at: www.state.ma.us/dfwele/dfw/nhesp/nhtown.htm. All federally

² (E) = Endangered; (T) = Threatened; (SC) = Special Concern

listed species that occur in Massachusetts are also state listed. The state list shows federal ranks when appropriate.

Vernal pools represent another important habitat for biodiversity protection. Vernal pools are typically small, shallow, temporary wetlands that seasonally provide important habitat to a variety of vertebrate and invertebrate species. The mole salamanders, such as the Marbled and Jefferson Salamanders, breed almost exclusively in vernal pools that do not have fish populations. The adults spend most of their time in the forest floor surrounding the pools where they hatched and developed, and return to breed in those pools in the spring. Many species of invertebrates find habitat in vernal pools, as well. For example, several species of Fairy Shrimp, small crustaceans, are adapted to, and depend on, the wet/dry cycles of vernal pools. The Natural Heritage and Endangered Species Program (NHESP) has identified 2,110 “potential vernal pools”(PVPs) in the Berkshire Ecoregions (**Figure 14**). More than 152 pools have been “certified” (Certified Vernal Pools, or CVPs) to-date. The Natural Heritage & Endangered Species Program “certifies” the occurrence of vernal pools based on documentation of the pool’s use by one or more groups of species that rely on vernal pools. This process relies on local effort of volunteers to identify vernal pools, and to collect and submit documentation. Partly as a result of the effects of uneven volunteer efforts, CVPs are unevenly distributed around the state – underlying topography also, of course, contributes to uneven distribution statewide. “Potential Vernal Pools” were identified through interpretation of aerial photographs as areas that were likely to be vernal pools, but for which there has not been ground checking. Potential vernal pools visible on aerial photographs were interpreted and included in the datalayer. However, this datalayer does not include every vernal pool in Massachusetts. Many vernal pools have not been identified due to unfavorable conditions in the landscape topography, pool physiography and/or photograph quality. Furthermore, vernal pool habitats occur in a wide variety of landscape settings, including forested swamps, bogs, and other wetlands. Vernal pools within these settings were not typically interpreted, but are nonetheless legitimate and valuable vernal pools.

Wildlife habitat value is largely influenced by the types, condition and successional stages of land cover types. The maintenance of regional biodiversity will ultimately depend on maintaining a mix of habitat types and conditions, including successional stages. While natural disturbances will over time result in some degree of habitat and seral stage diversity, it is generally acknowledged that active forest management plays an important role in providing such habitat diversity in a more planned and predictable manner. A range of forest age classes, from young, regeneration stage forest to large sawtimber forest is crucial for providing diverse wildlife habitats in the forested ecosystems of southern New England (**DeGraaf et al. 2005**).

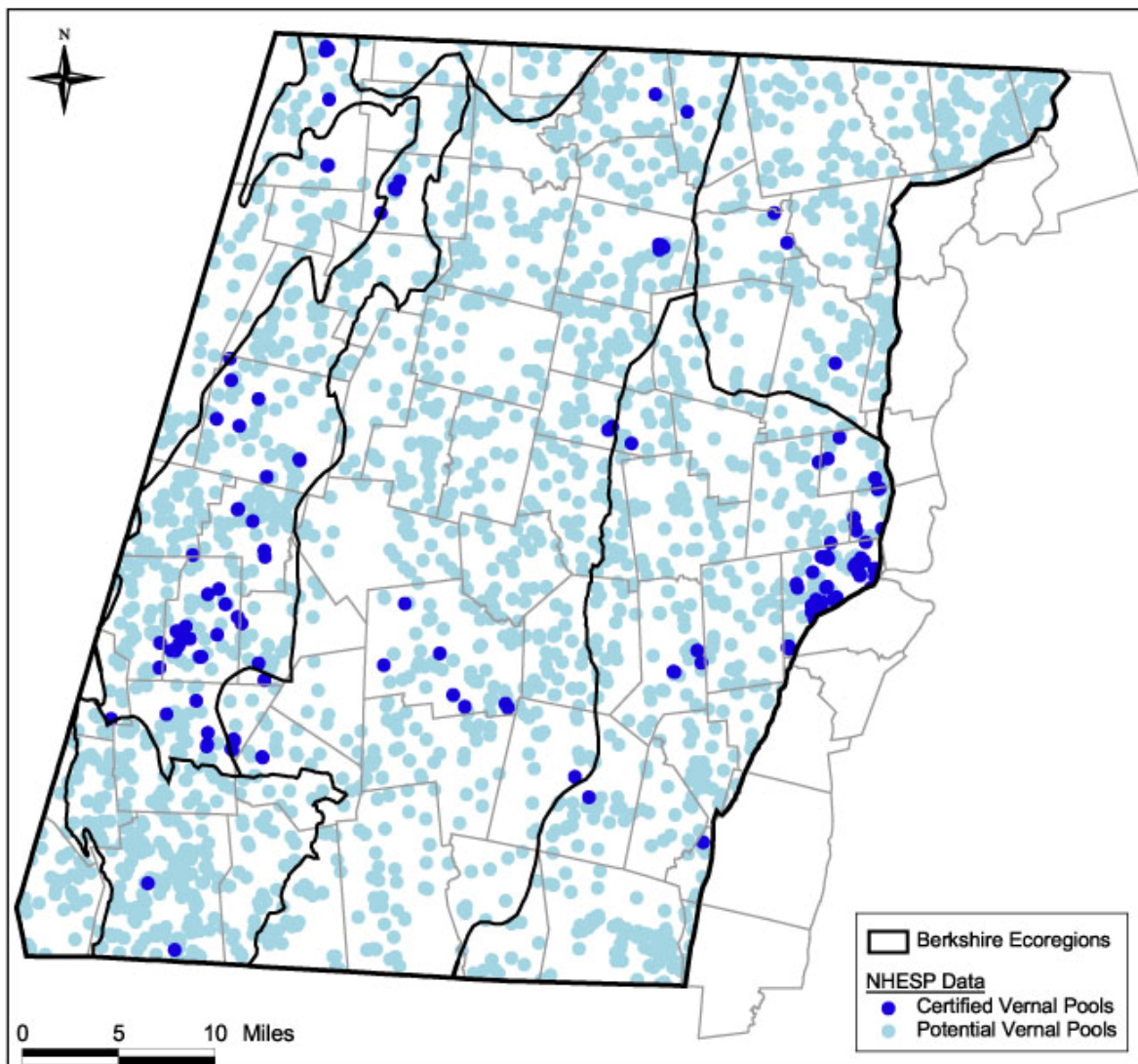


Figure 14. Potential and certified vernal pools in the Berkshire Ecoregions.

DFW’s forest composition goals for state wildlife lands include 15-20% early-seral forest (seedling, sapling, and small pole stages generally ≤ 30 years old), 65-75% mid-seral forest (large pole and sawtimber stages generally 30-150 years old), and 15% late-seral forest (generally dominated by trees > 150 years old). Private forest landowners may not be able to devote any of their property completely to late-seral forest for economic reasons, but can still manage their land to provide important structural attributes of late-seral forest. This can be done by retaining clusters of large, healthy mast-bearing trees such as oak and beech through two or more rotations, retaining den and cavity trees, and accumulating large, downed woody debris. These structural attributes provide important habitat for wildlife species with limited dispersal abilities (such as salamanders and various invertebrate animals), and also provide food and cover resources for more familiar bird and mammal species (such as cavity-dwelling birds and mammals).

As previously shown (see Section II. The Setting, **Table 3**), the Berkshire Ecoregions are dominated by forest cover (79.09%). Just less than ten percent (9.66%) is agricultural or open, 3.35 percent is wetlands or open water, and almost eight percent (7.9%) is developed. The USDA Forest Service FIA³

³ FIA – Forest Inventory Analysis (see www.fs.fed.us/ne/fia/states/ma/index.html) See: “IV. Forest Conditions, Health, and Productivity – Current Forest Conditions” section of this assessment for FIA data qualifying statement.

data shows that the majority of the forestland in these ecoregions (about 74%) is “Mature” (i.e. - in sawtimber classes). About 22% is in “poletimber” stage (define by dbh), and only 3.8% is in early seral stages (i.e. - seedlings or saplings). This age class distribution is even more skewed towards older stands than statewide figures (**Figure 15**). As a result, the wildlife community in this ecoregion at the present time is likely to be dominated by species adapted to mature forest conditions (i.e. - late seral stage).

Habitat value is also influenced by decisions made during both the marking and actual harvesting of forest stands. In addition to protecting uncommon or known rare species habitats, land managers should also plan for the maintenance of specific habitat conditions such as coarse woody debris, snags and den trees, and other habitat features important to wildlife species.

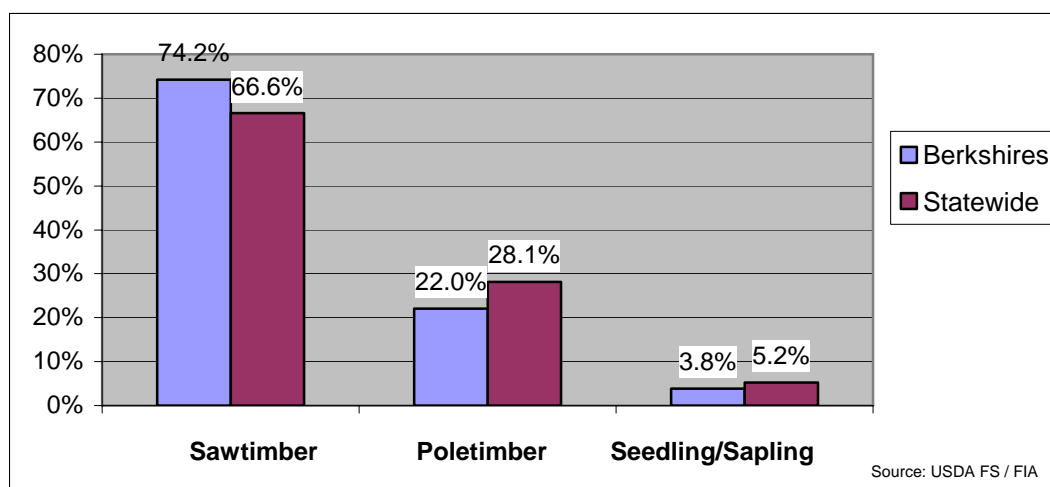


Figure 15. Age class distribution of forestland in the Berkshire Ecoregions and statewide, 1999.

Fisheries Resources in the Berkshire Ecoregions

The Berkshire Ecoregions are home to a wide diversity of fisheries resources and contains portions of six major drainage basins. The Berkshire Ecoregions contains portions of the Connecticut, Farmington, Housatonic, Westfield, Deerfield, and Hudson watersheds (**Figure 5**). DFW has conducted intensive fish sampling in all of these watersheds as part of its statewide monitoring and assessment program (see program description below).

Extensive research has been conducted in the Housatonic watershed to outline specific watershed-based restoration efforts using fisheries information. This research was first described for the Quinebaug River (Parasiewicz and Goettel, 2003). The objective is to determine the fish community that is reasonable to expect in the Housatonic River (the Target Fish Community or TFC). The basic assumption of the TFC approach is that rivers should be comprised, primarily, of fluvial (river) fish species. Further research in all watersheds will include the establishment of TFCs, habitat mapping and the development of Indexes of Biotic Integrity (IBIs) to assess the aquatic resources across the state as part of the Fisheries Conservation and Restoration Initiative.

From 2001 to 2004, DFW has conducted 214 samples on waterbodies within the Berkshires (**Figure 16**). More than 32,500 fish were collected of 38 species of fish and three hybrids. More than 246 coldwater fisheries resources have been identified within the Berkshires. Data collected in the Berkshire Ecoregions will be used to identify high priority sites for restoration, excellent fishery resources, and priorities for land acquisition. Summaries of the fish communities within the Berkshires will be prepared that will describe the fishery resource on a watershed and sub-watershed scale.

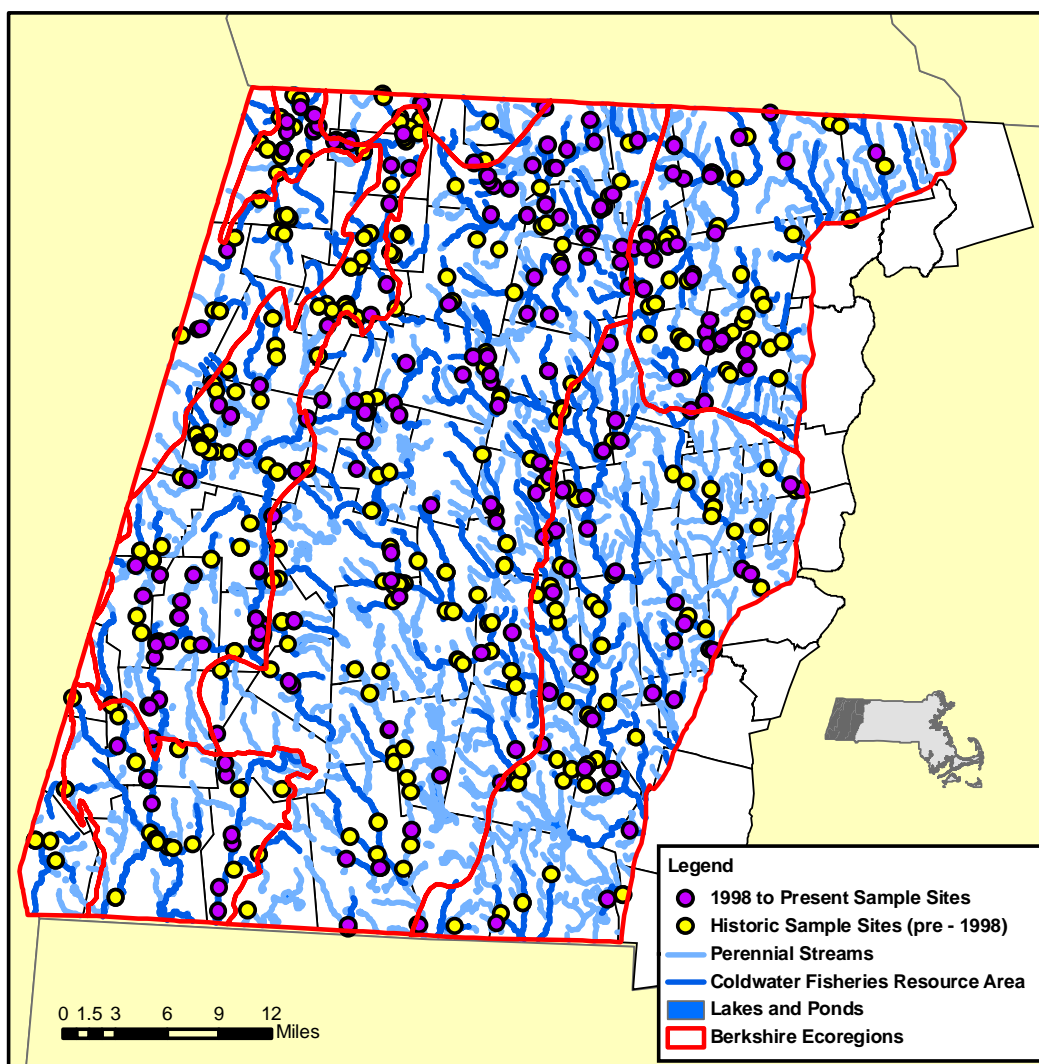


Figure 16. Locations of Fisheries Assessments in the Berkshire Ecoregions⁴.

Although all watersheds discussed below have important aesthetic and recreational value, the following summaries focus on unique, exemplary, or severely degraded conditions within the Berkshire Ecoregions. These summaries should be considered as examples only, and not taken to indicate a full account of the resources found in the Berkshire Ecoregions. Additional data can be obtained from the MDFW to fully describe the aquatic resources in the Berkshires. These summaries will focus on two issues: a) the status of certain Coldwater Fishery Resources (CFRs); and b) the proportion of fish in the samples that are fluvial (river) fish species. A CFR is defined as a water body that support wild reproducing brook, brown, or rainbow trout, slimy sculpin, longnose sucker, or is part of the Atlantic salmon restoration effort. CFRs, in the absence of adequate fishery information are also defined in part, in the Massachusetts Water Quality Standards, as those not typically exceeding 68° Fahrenheit in the summer months. As described later in this document, fluvial species are those that require flowing water to meet at least one, and sometimes all, of their life stage requirements. Fish species other than fluvial species will be referred to as generalist species.

⁴ The “Fisheries Assessment” sample sites and the “Coldwater Fisheries Resource Areas” data were obtained from DFW. The current “Coldwater Fisheries Resource Areas” data in **Figure 16** was not available at the time this document was finalized. A current statewide list of the “Coldwater Fisheries Resource Areas” is available at the Division HQ in Westboro, MA and is updated annual by DFW.

Connecticut River Watershed

Only a small portion of the Connecticut River watershed exists within the Berkshire Ecoregions. Urbanization, impoundments, and water quality issues are all factors affecting the fish community of the Connecticut watershed.

Twelve samples were collected on ten streams in the Connecticut River Watershed portion of the Berkshire Ecoregions from 9/17/01 to 9/10/03. All streams sampled were Coldwater Fishery Resources (CFRs). The effort resulted in 2881 fish of 15 species. These streams are in highly sensitive areas and further urbanization or water allocation will result in the elimination or degradation of these coldwater fishery resources. All streams were comprised of native fluvial (river) fish species. Of concern is Blue Meadow Brook. A sample of 74 meters resulted in only two fish. Water levels were very low during the sample and may have been a result of natural conditions but should be examined for other possible impacts. Hannum Brook and the Manhan River had populations of slimy sculpin in addition to wild salmonids or stocked Atlantic salmon. Sculpin are very sensitive to disturbance. These resources need a great deal of attention in order to avoid impacts to these species. The Mill River (SARIS # 3418825) produced Slimy Sculpin in 1979 and surveys conducted since then have found none.

Deerfield River Watershed

From 6/12/00 to 7/9/03, 62 samples were taken from the Deerfield River Watershed portion of the Berkshire Ecoregions. These samples were gathered on 47 streams and rivers. All waters sampled during this effort qualified as CFRs. In total 5101 fish of 19 species were captured. Brook trout, Atlantic salmon, blacknose dace, and slimy sculpin dominated the catch, comprising more than 75% of the fish sampled. The Deerfield watershed is dominated by coldwater resources. These resources are impacted by hydropower regulation, agricultural runoff and loss of connectivity caused by dams, roads, and culverts. While this watershed still has intact resources, most sites have been degraded by some development and others are severely degraded. Green River, Kinsman Brook, Legate Hill Brook, and North River all had very low densities of fish. These densities were unexplained by any sample parameters gathered during the survey procedure. Almost all streams sampled were dominated by native fluvial fish. Sids, Basin, and Bozrah Brooks, however had 19, 79, and 18% generalist (pond) species. The condition of these resources should be further explored.

Westfield River Watershed

From 6/25/2001 to 9/12/2003, 52 samples were collected from the Westfield River watershed portion of the Berkshire Ecoregions. These samples were gathered on 39 streams, rivers, and one lake. Of the waterbodies sampled, 37 are considered CFRs. Only Littleville Reservoir and the Mainstem of the Westfield River are not considered CFRs. The mainstem of the Westfield River, however, is an extremely important resource for migrating Atlantic salmon and conditions within the mainstem should be protected and restored to increase the likelihood of the Atlantic salmon Restoration effort. There were 8750 fish captured of 27 species and 1 hybrid. Blacknose dace (31%), Atlantic salmon (18%), brook trout (16%), longnose dace (12%), and slimy sculpin (6%) accounted for the majority of the catch. Native, fluvial fishes (dependants and specialists) accounted for 93% of the catch. The Westfield watershed is dominated by coldwater resources. Although these resources are impacted by impoundment (especially the mainstem of the Westfield River proper), hydropower regulation, agricultural runoff and loss of connectivity caused by dams, roads, and culverts, there remains a great deal of biotic integrity within the watershed. For example, samples on Abbott Brook, Gibbs Brook, Shaw Brook, and Phelps Brook resulted in sculpins and brook trout only. These species are indicative of cold, clean water and relatively undisturbed conditions. Pond Brook samples were highly varied. One sample consisted of brook trout only. Another sample, however, consisted of 18% macrohabitat generalists and a trout population dominated by brown trout. Brown trout are an exotic species with great recreational value but are also more tolerant of reduced water quality. Pond Brook also had one of the lowest densities of fish (when measured via number of fish caught per unit of effort (CPUE) - in this case number of fish captured per

second of sample time). Kinne Brook not only had a very low CPUE, but also had a fish sample that consisted of only blacknose dace. Blacknose dace are relatively tolerant of alterations to water quality. Previous samples of Kinne Brook, from 1977 to 1988 all included or were dominated by wild brook trout. Two of the four historic samples included slimy sculpin as well.

Housatonic River Watershed

From 7/11/02 and 9/11/03, 63 samples were taken in the Housatonic Watershed portion of the Berkshire Ecoregions. The watershed-wide sample resulted in 11,362 fish captured of 32 species. Rock bass (16%), blacknosed dace (14%), yellow perch (11%), longnose dace (10%), smallmouth bass (6%), white sucker (5%), bluegill (5%), brown trout (5%), and brook trout (5%) were the majority of the fish caught. Twenty-eight water bodies were sampled which consisted of 4 rivers, 16 brooks, 4 lakes and 2 ponds. Of the water bodies sampled, 17 out of the 28 are classified as CFRs. The MDFW database currently lists 47 water bodies within the Housatonic watershed as being CFR's.

There were 6 samples that were comprised entirely of fluvial fish species; Tyler Brook, Welch Brook, Churchill Brook, Greenwater Brook, Windsor Brook, and Cady Brook all collected fluvial fish only. Onota Lake had the highest yield of fish with 1,123 fish caught. This sample also had the most variety of species with 19 species collected. The sample was dominated by yellow perch (73%). Hop Brook had the highest yield of fish for the rivers and brooks sampled, with 682 fish caught. The total consisted of 10 species of fish, 99% of the total were fluvial (both dependants and specialists). The majority of the sample consisted of blacknosed dace (62%), longnose dace (20%), and common shiners (10%). Hop Brook also had the highest CPUE of all the sites sampled in the Housatonic River watershed. At least 7 waterbodies were comprised of more than 10% macrohabitat generalists and 4 waterbodies (Housatonic River, East and West Branches of the Housatonic, and Williams River) had more than 35% MGs. Most of those samples were conducted on the mainstem Housatonic River. The lowest yielding sample was on the Konkapot River with only 2 fish, a common shiner and a rock bass. This sample also accounted for the lowest CPUE of all the samples. The CPUEs of the four other samples conducted on the Konkapot River were low as well, within the 20 lowest CPUEs of the 63 samples. Farmington River Watershed.

Farmington River Watershed

Eight samples were taken from 6 different sites in the Farmington River Watershed. Five of the 6 locations were brooks, the 6th being the West Branch of the Farmington River. Only 3 of the locations are Coldwater Fishery Resources (CFRs): Riiska Brook, the Mainstem Silver Brook and the North Branch Silver Brook. These samples were taken between 7/11/01 and 9/18/01. A total of 607 fish of 18 species were collected, 86% of them being fluvial (both dependants and specialists). The majority of the fish captured were consisted of fallfish (21%), blacknosed dace (17%), common shiner (16%), brook trout (13%), and white sucker (6%). The sample taken at Riiska Brook consisted of 5 species of fish, all of which were fluvial. A similar finding was made for the Mainstem and North Branch of Silver Brook, although only 2 species of fish (blacknosed dace and brook trout) were captured. Riiska Brook was the only brook sampled in the Farmington River Watershed that yielded atlantic salmon. One section of the West Branch Farmington River yielded 18 fish of 4 species, only 4 of the fish sampled (tessellated darters) being fluvial. Two other sections of the West Branch Farmington River yielded mostly fluvial fish except for 1 species of non-fluvial fish (smallmouth bass). Lake Marguerite Brook yielded the lowest number of fish (11). Five of the fish captured were pond (non-fluvial) fish. The Otis Reservoir Brook sample totaled at 141 fish, 7 of those fish were comprised of macrohabitat generalists.

Hudson River Watershed

From 6/18/02 to 7/30/03, 20 samples were taken from 14 locations in the Hudson River Watershed. These water bodies consisted of 12 brooks, 2 rivers, and 1 reservoir. Only 3 out of the 14 sample sites are not CFRs; Cheshire Reservoir, Flora Glen Brook, and Paul Brook. The MDFW database

currently lists 36 waterbodies within the Housatonic watershed as being CFR's. In total, nearly 3,000 fish of twenty species of fish were found. The majority of fish that were captured consisted of blacknose dace (35%), slimy sculpin (14%), longnose dace (12%), brown trout (11%), brook trout (9%), white suckers (6%), and creek chubs (5%). All stream and river samples were dominated by fluvial (both specialists and dependants) fishes. Samples in Kinderhook Creek and the West Branch of the Green River resulted in only brook trout, brown trout, and slimy sculpin. The Tunnel Brook sample resulted in only 1 species: brook trout. Fish population consisting of only coldwater species are unique in Massachusetts and are in considerable decline. Paul Brook had the lowest CPUE of the samples taken, with only 40 fish found. All 5 of the species were fluvial specialists. With its habitat a heavy rust color, Flora Glen Brook resulted in blacknose dace only, which tend to be tolerant to pollutants. Despite the high flows at the time of sampling, 2 of the 4 samples on the Hoosic River yielded high totals of fish, one being the most varied in species of all the Hudson River Watershed samples with 12 species. Hudson Brook and Hemlock Brook were completely dominated by fluvial fish.

The DFW Fisheries Conservation and Restoration (FCR) Initiative

The FCR Initiative focuses available DFW resources, on a watershed basis, to protect fisheries habitat. The objectives are to:

- Assess the current status of fisheries resources.
- Identify fisheries habitat restoration projects.
- Identify land acquisition priorities.
- Develop watershed-based fisheries management plans.
- Maintain a comprehensive fisheries database.
- Conduct environmental review and assessment.
- Provide technical assistance and biological data to government agencies, local conservation commissions, and private organizations involved in habitat management and protection.

The fishery assessment gathers information about fish species diversity, relative abundance and length frequency distribution. Backpack, barge, and boat-operated electrofishing units are the primary sampling mechanisms. Backpack shockers are best used in small shallow streams and are designed for headwater reaches. Barge electroshockers are designed to be used in wadeable streams with depth or current flow that make backpack shockers inefficient. Boat shockers will be used in lakes and rivers that are too deep to wade and where more power output is required.

Sampling locations are selected based on available access, water conditions and habitat type. Fish sampling crews conduct site visits to rivers and lakes to determine suitable access locations and sampling sites. Lotic habitat types (riffle, run, pool, etc.) and lentic habitat types (eutrophic, mesotrophic, oligotrophic) will be sub-sampled in proportion to their availability as determined by site visits. Data collection will take place from May 15 to September 15.

Stream and River Sampling

Crews of three to five people conduct single pass electrofishing surveys through previously selected sites. The beginning and ending points will be marked on USGS 1:25,000 topographical maps. Sample sites include at least 100 meters of stream length. In situations where 100 meter reaches are not practical or possible, length of stream sampled is measured by tape.

Crews begin at the downstream end of a sampling site and shock to the upstream ending point. Crewmembers use dipnets to capture fish that roll off the bottom or rise to the surface. All fish are kept alive in five-gallon buckets, livecages positioned along the sample reach, or a livewell in the boat.

Lake and Pond Sampling

Crews of three to five people sample shoreline areas by making a single pass with an electrofishing boat. The beginning and ending points for the sampling site are marked on USGS 1:25,000 topographical maps. The crew conducts at least three total-pickup collections of at least 15 minutes each. During this process, all fish are collected and placed into the boat livewell. Other sampling methods (gillnet, seine) might also be employed to most effectively meet the sampling objective.

Data Collection

The first 100 fish of each species will be identified and measured to the nearest millimeter (except American eels and sea lampreys that will be measured to the nearest centimeter). The remaining fish in each species are tallied by species with no length taken. No more than two percent and no less than two individuals (or one if only a single specimen is collected) of each species captured will be preserved in 10% formalin for confirmation of identification by laboratory analysis. Live fish that are not retained for preservation are returned to the sample site.

Habitat Evaluation

Qualitative habitat assessments are conducted in conjunction with fish sampling to evaluate the condition of the available habitat as it relates to fisheries resources. Stream width, canopy enclosure and species composition, channel morphology, and anthropogenic influences are noted and assessed. Standardized habitat evaluation forms are also used to assess habitat quality. Lake habitat is characterized by morphology, local development and land use practices. Format and content of the information to be gathered concerning habitat measurements follows established guidelines used by the Department of Environmental Protection (DEP) and the Fisheries Section.

Analysis

Information gathered during the course of the study will be entered into a database designed to be accessible to all parties involved with watershed management. Microsoft Access will be used as a standard format for data entry, storage, and manipulation. Initial summaries will be generated by statistical software to outline and highlight the information gathered during the sampling period. Summaries will include information about sampling locations (number of sites, towns sampled), sampling effort statistics (length of river sampled, types of gear used, estimates of efficiency), number and description of species encountered (relative abundance, common and scientific names, literature-documented tolerances) and habitat scores or descriptions for the sample sites. Further analyses relating habitat and fishery characteristics will be provided in final reports and will focus on delineating change in fishery characteristics with changes in available habitat.

Products

Several products will result from this effort. This information will be used internally for several habitat and fisheries assessments, database development, land acquisition, environmental review and assessment, and public access prioritization. Completed watershed-based fisheries management plans will include summarized information from fisheries and habitat assessments and options for improving habitat quality. Examples of these projects include in-stream fish structures, riparian stabilization, maintenance of buffer strips, and public involvement and outreach.

One of the products emerging from the Assessment process is the development of Target Fish Communities. The Target Fish Community methodology was developed to describe a community of fish, using regional distribution and local relative abundance information that is appropriate for a natural river in southern New England. The TFC is used as a benchmark for assessing an existing community and to identify the nature of departures from the TFC. To date the TFC process has been employed in the

Quinebaug, Ipswich, and Housatonic Rivers. The intent is to establish TFCs statewide, either by watershed or regionally.

Specific products that have resulted from the FCR Initiative include the Quinebaug research (Parasiewicz and Goettel, 2003) and a series of reports published by the USGS (Armstrong et al. 2001, Armstrong et al. 2003, Armstrong et al, in press).

Working Forestlands

The sustainable harvesting of renewable wood products is essential for private forestlands to remain economically viable, and for private and public forestlands to support rural economies. Working forestlands contribute a range of economic, ecological and aesthetic qualities that benefit all citizens of the Commonwealth.

From an economic standpoint, all Massachusetts residents use wood products each and every day, and harvesting of wood products from public and private forestlands provides raw materials for processing and manufacturing jobs that would otherwise be lost to other states and countries. Massachusetts, and the Berkshire ecoregions in particular, have great potential to add wood processing and manufacturing jobs to stimulate local economies. However, a combination of energy, taxation, labor, and permitting costs, as well as other factors make it difficult for existing processors and manufacturers to expand, and for new ones to become established.

The Berkshire Ecoregions and Massachusetts as a whole have seen a dramatic loss of sawmills and other wood processing industries over the past several decades (see Section VII. Socio-Economic Factors, *Sawmills*, **Table 23**). Yet the annual production of sawtimber from Massachusetts remains relatively constant at around 80-90 million board feet reported under Chapter 132 forest cutting plans, plus additional sawtimber cut from forestland as it is converted to development. Some and perhaps most of the sawtimber volume cut from Massachusetts forestlands is exported as whole logs to other states or countries (see Damery, D. T., G. W. Boyce, 2003, p.34) so the supply of sawtimber does not appear to be the major issue for the long-term decline in the wood processing industry in Massachusetts. Rather, it seems that business costs make it difficult for the wood industry in Massachusetts to compete with other states and countries (e.g., Canada) where the business climate is friendlier to the wood processing industry.

From an ecological standpoint, sustainable timber harvesting provides clean air, clean water, and early-successional forest habitat that supports a diversity of native wildlife species that are currently experiencing long-term population declines (see the draft Massachusetts Comprehensive Wildlife Conservation Strategy at: www.mass.gov/dfwel/dfw/cwcs/dfw_cwcs.htm). According to harvest volumes reported under Ch. 132 forest cutting plans, about 25% of the growing stock is removed in an average harvesting operation. Rarely are Massachusetts forestlands fully regenerated to an early-successional condition, and this has negative impacts on native wildlife species associated with young forest habitats.

From an aesthetic standpoint, people enjoy having an abundance of forestland across the landscape, and enjoy the fact that private forestlands contribute more to local tax bases than they cost in community services. While some may not find a recent regeneration harvest aesthetically pleasing, the fact remains that sustainable harvesting is essential if private forestlands are to remain economically viable. Alternatively, private forestlands are often converted to residential development, which typically costs more in community services than it contributes in tax revenues.

A Forest Reserve System for Massachusetts and the Berkshire Ecoregions

EOEA has initiated a process to identify potential forest reserve sites on state lands where commercial timber harvesting will not occur. A primary goal for reserves is to establish relatively un-

fragmented sites where the structure and composition of the forest ecosystem is determined primarily by natural disturbance processes.

The current scientific literature documents the benefits of having areas of forestland that are reserved from extraction of both non-renewable natural resources (e.g., fossil fuels and gravel) and certain renewable resources including wood products (see for example Alverson et al., 1994; Vora, 1994; Hunter, 1996b; Andersen, 1999; Norton, 1999). Forest reserves help ensure that representative examples of biodiversity indigenous to an area are conserved, and also provide reference sites for objective assessment of the sustainability of extractive forest management practices (Norton, 1999).

Forest reserves are also important for practicing adaptive resource management (Walters and Holling, 1990). Reserves create opportunities for connectivity within the landscape, conservation of species and processes, buffering against future uncertainty, and other hard to measure but valuable functions (Hunter, 1996b). Potential benefits of forest reserves include development of primary herbaceous communities on the forest floor (Meier et al., 1995), unique assemblages of lichens and bryophytes (Dunwiddie et al., 1996 and Flatebo et al., 1999). Over time, reserves will accumulate large quantities of coarse woody debris that will likely diversify invertebrate wildlife communities.

It is critical to remember that a major benefit of reserves is to verify the sustainability of harvested sites. Reserves will be a relatively small component of extensive forested landscapes in Massachusetts that are dominated by working forestlands. Presently, all wood products harvested from Massachusetts forestlands are equivalent to <5% of all wood products consumed in the state (Berlick et al. 2002). Local production of renewable wood products is also essential to avoid shifting wood harvest to other regions of the world with less stringent environmental regulations (Berlick et al., 2002) which can potentially exacerbate tropical deforestation (Sohngen et al., 1999). The economic value of forest harvesting to rural communities in Massachusetts is substantial (generating over \$700 million annually), and could be increased two- or three-fold if all forestlands in the state were sustainably managed to produce wood products (Berlick et al. 2002). Reserves will provide important “control” sites to help evaluate the sustainability of management on “treated” sites that are harvested.

For forestry practices to be certified as sustainable, FSC requires the conservation of biological diversity, critical resources, and unique and fragile ecosystems in order to maintain ecological functions and integrity. Specifically, FSC requires:

1. The establishment of conservation zones and protection areas that protect rare, threatened, or endangered species on the property.
2. The protection of representative samples of existing ecosystems. These samples must serve to establish or maintain reference conditions, protect under-represented conditions, and/or protect sensitive, rare, or unique features.

Each of the three divisions (DCR: DSPR & DWSP and DFG: DFW) within EOEA, participating in the SCS/FSC forest certification audit, has previously made independent efforts to incorporate some aspects of a forest reserve system into their land management planning. Examples include: the DSPR old-growth forest policy, GOALS zoning of “protection” forest and designation of almost 20 Backcountry Areas or Representative Natural Areas (under 304 CMR 7.00), the DWSP “areas of special management restrictions” in the Quabbin Reservation and Wachusett Reservoir Land Management Plans and “strategy 1” lands in the Ware River Land Management Plan, and the DFW provision that 10-15% of state wildlife lands occur as late-seral forest habitat. Each of these various efforts generally restricts or prohibits extraction of wood products, and imposes other management restrictions. SCS has accepted the current system of unmanaged lands within DWSP properties as meeting FSC requirements.

A variety of inter-related ecological attributes have been proposed as important in reserve design, including: representativeness (inclusion of the full range of natural variation characteristic of a region), species-area relationships (larger areas tend to support more species than smaller areas of the same habitat

type), metapopulation dynamics (migration between spatially discrete population assemblages), landscape position (minimizing fragmentation and providing connectivity), natural disturbance regimes (accounting for infrequent, large-scale disturbance), climate change (inclusion of elevation and aspect gradients), and restoration ecology (inclusion and rehabilitation of human-modified environments when few or no quality examples remain on the landscape [e.g., floodplain forest])(Norton, 1999).

Another vital component of reserves is management of the matrix lands surrounding a reserve that are open to wood products extraction. Application of extended rotation silviculture with retained 'islands' of mature trees in areas adjacent to the reserve has the potential to substantially enhance biodiversity conservation within the reserve (Norton, 1999).

Both occasional large and multiple smaller forest reserves representing a wide range of ecological diversity are warranted to meet the purposes of forest reserves (Vora, 1994). Designation of reserves at multiple scales (e.g., relatively small patch reserves of tens or hundreds of acres, and extensive relatively unfragmented 'matrix' reserves of thousands of acres) is promoted by The Nature Conservancy, which has also pioneered planning on an ecoregion basis as a viable means of biodiversity conservation in the Northeast (Andersen, 1999). TNC has recently completed an ecoregional analysis of viable and representative forest areas in the Northeastern United States (Anderson and Bernstein, 2003) that could facilitate discussion of occasional large "matrix" reserves in Massachusetts.

Multiple patch reserves can form key components that protect particular combinations of biodiversity that are not present elsewhere in the landscape, and can facilitate plant and animal migration that sustains viability of metapopulations (Andersen, 1999 and Norton, 1999). Further, occasional large 'matrix' reserves of $\geq 15,000$ acres in Northeastern forests may absorb infrequent large-scale disturbances that can range up to 5,000 contiguous acres, and allow re-colonization of disturbed portions of a reserve from adjacent, undisturbed portions of the reserve (Alverson et al., 1994 and Andersen, 1999).

Landuse Trends and Forest Fragmentation

Trends in landuse in the Berkshire Ecoregions from 1985 through 1999 show a 7.4% decline in agricultural/open land and a 0.5% decline in forest cover, with a 17.2% increase in the amount of developed land (see Section II., **Table 4**). While some of this change came at the expense of the forest cover (4,839 acres), the loss of more than 8,752 acres of agricultural and open land during this period is cause for concern, since it represents almost 8% of the total acreage of agricultural/open land. These trends also impact species composition and biodiversity in the ecoregions

Associated with the loss of forest cover is the sub-dividing or fragmentation of existing forested areas. The USDA Forest Service data shows that statewide, the average size of forested parcels continues to decline. It is estimated that the number of landowners with fewer than 50 acres of timberland has more than doubled since 1973 (USFS, 2002). Further, the most recent Forest Service survey of timberland in Massachusetts showed that nearly 75% of forested sample points were within $\frac{1}{4}$ mile of the forested edge, thus potentially subjecting them to more human influences and other edge effects than areas that are more distant from developed land (USFS, 2002).

Another indirect measure of fragmentation is the density of roads, rail lines, power lines and other linear developed corridors on the landscape. Altogether, approximately 2,065 miles of these features occur in the Berkshire Ecoregions, including almost 1,493 miles of roads, 265 miles of rail lines, and 307 miles of transmission lines (**Figure 17 and Table 7**). This translates to approximately 1.17 miles of linear infrastructure per square mile of area in the Berkshire Ecoregions.

Although forest fragmentation is undoubtedly occurring in portions of the Berkshire Ecoregions, it appears that it is not a major issue for the ecoregions as a whole at the present time. MassGIS data on

contiguous natural lands (**Figure 18**) suggest that these ecoregions still have significant areas in relatively contiguous forest cover. Additional information on this data is provided in **Appendix VII**.

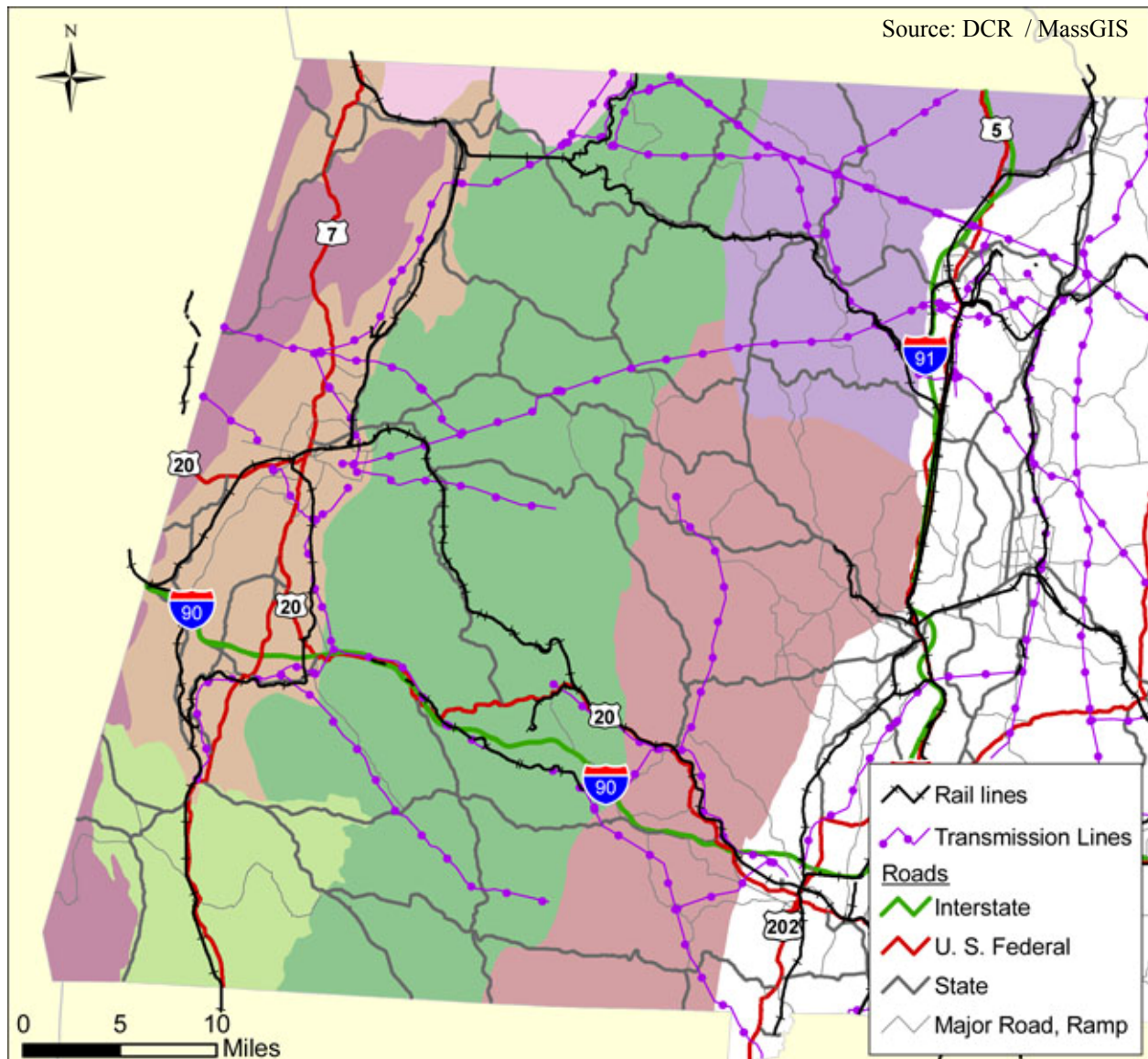


Figure 17. Infrastructure (roads, rail lines and transmission lines) in the Berkshire Ecoregions.

Table 7. Infrastructure (roads, rail lines and transmission lines) in the Berkshire Ecoregions)

Ecoregion	Transmission Lines	Rail Lines	Roads				
			Interstate	US Fed Rds	State Rds	Major Rds	Total Rds
Berkshire-Vermont Upland	111	100	37	20	161	45	474
Hudson Highlands	49	28	15	23	117	121	352
<i>Berkshire Transition Association</i>	46	17	15	12	82	104	275
<i>Western New England Marble Valley Association</i>	3	11	-	11	35	17	77
Southern Green Mountains	7	2	-	-	2	3	14
Southern Vermont Piedmont	60	37	15	6	59	39	215
Taconic Mountains	80	99	21	52	111	74	437
<i>Taconic Highlands Association</i>	9	0	-	-	14	10	33
<i>Western New England Marble Valley Association</i>	70	99	21	52	98	65	-
Totals:	307	265	88	101	450	282	1,493

Source: MassGIS as of Feb 28, 2005

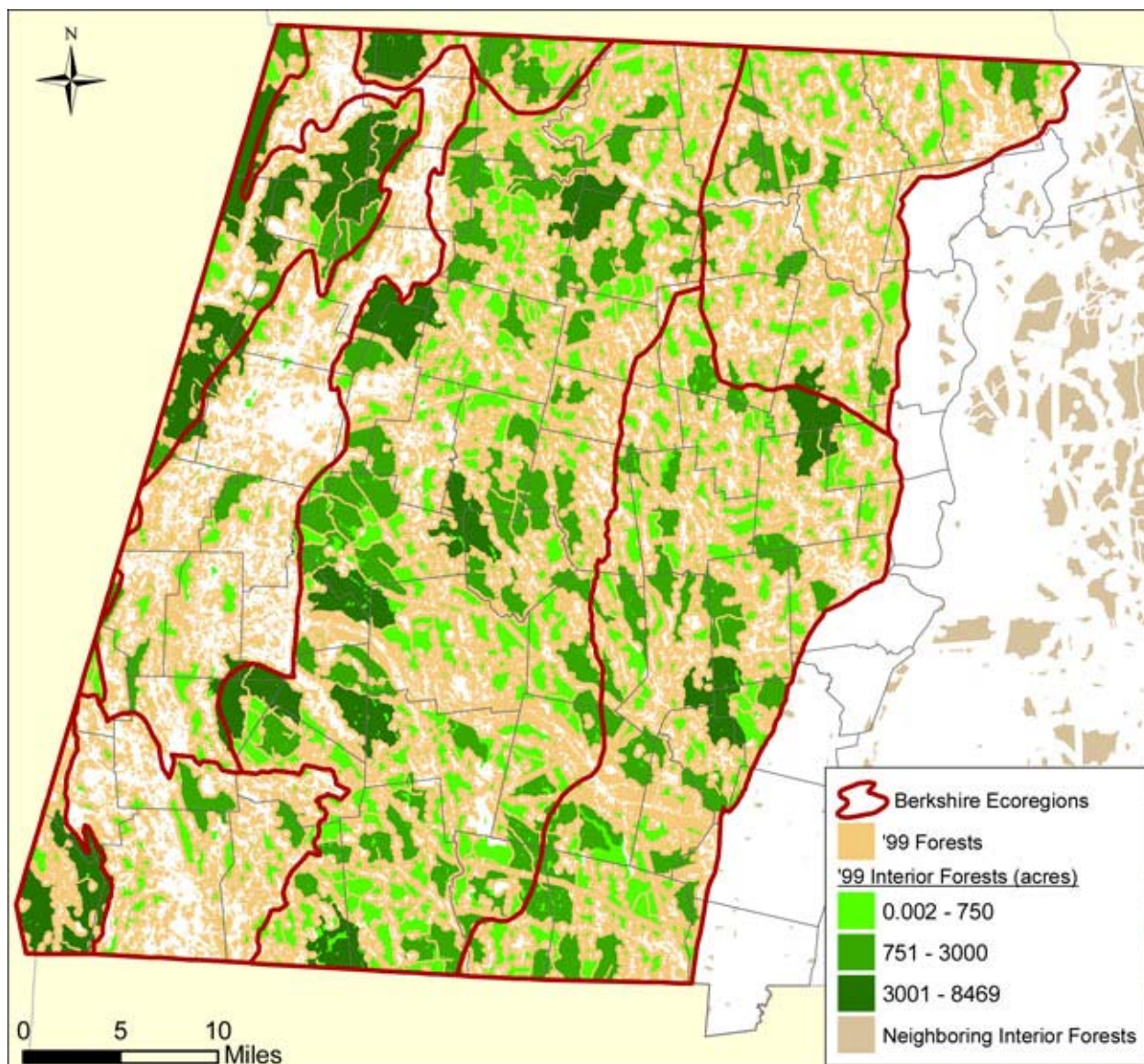


Figure 18. “Buffered and Unfragmented “Forests⁵” and “Natural Features⁶” in the Berkshire Ecoregions

⁵ “Interior Forest” include the MassGIS 1999 landuse, code(3)/category(Forest), buffered from fragmenting features (e.g., roads and development) by distances of 100 -1,000m.

⁶ “Natural Features” include the MassGIS 1999 landuse, codes (4, 14, & 20)/categories (wetland, salt marsh, & water), buffered from fragmenting features (e.g., roads and development) by distances of 100 -1,000m.

Invasive Plants

Another potential threat to the future forest and habitat conditions in Massachusetts and the Berkshire Ecoregion is the proliferation of invasive plant species. Non-native or exotic plant species have been brought into Massachusetts intentionally as planting stock and many others arrived accidentally. Some species, like Ox-eye Daisy and Dandelion are common statewide and considered “naturalized” regionally. These two species and many others have become recognized as a component of our landscape and do not appear to be threatening undisturbed habitat of native species. However, some non-native plant species are relatively new to our landscape and aggressively replace native plant populations. These “invasive” non-native plants represent a threat to the biodiversity of the state as well as the Berkshire Ecoregions (Wilson. 2002).

The Massachusetts Invasive Plant Advisory Group (MIPAG), a voluntary collaboration between public and private organizations representing state and federal governmental agencies in fish and wildlife, agriculture, and natural resources; the horticulture industry; academic science institutions; land management and nonprofit conservation organizations. MIPAG has summarized invasive plant concerns for the Massachusetts landscape in a February 28th 2005 final report “Strategic Recommendations for Managing Invasive Plants in Massachusetts” and has evaluated non-native plant species in their April 1st 2005 report “The Evaluation of Non-Native Plant Species for Invasiveness in Massachusetts”, both at: www.mass.gov/dfwele/dfw/nhesp/heritage2.htm.

Following the MIPAG work above, the Massachusetts Department of Agricultural Resources (DAR) has implemented a ban on 140 plants identified as either noxious and/or invasive. This action became effective on January 1, 2006. The ban is limited to the importation, sale, trade, distribution and related activities, of the 140 plants identified on the list, and does not affect any existing plantings. The ban will phase in 14 of the 140 plants on the list (effective January 1, 2007 for 4 plants and January 1, 2009 for 11 others). The list can be found on the DAR web site at: www.mass.gov/agr/farmproducts/proposed_prohibited_plant_list_v12-12-05.htm. This action was taken after much discussion through the collaborative effort of the Department, the Massachusetts Nursery and Landscape Association (MNLA), the Massachusetts Invasive Plants Advisory Group (MIPAG), and other agricultural organizations over a three year period. A public comment period was held from July 11, 2005 through September 30, 2005. Additional information can be found on the DAR web site at: www.mass.gov/agr/farmproducts/Prohibited_Plant_Index2.htm.

Another important effort currently underway is the Invasive Plant Atlas of New England, (IPANE; invasives.eeb.uconn.edu/ipane) a volunteer training and coordination effort to develop spatial and descriptive information documenting the current state of invasive plants in the region, as well as broad education of the public on the dynamics of invasions and methods for addressing the issues. IPANE is a relatively new effort, so that its database information is incomplete. Nonetheless, this database already holds 548 documented occurrences for 42 different species within the towns of the Berkshire Ecoregions. Twenty-three of the 70 communities in the Berkshire Ecoregions have documented occurrences of invasive plants, and it is likely that those so far missing from the database are not invasive-free.

To date, the most commonly documented species in the Berkshire Ecoregions are leafy spurge (*Euphorbia esula*) and common buckthorn (*Rhamnus cathartica*), although this does not mean these are the most extensive populations. Purple loosestrife (*Lythrum salicaria*), amongst the most widely publicized wetland invasives, is becoming more and more common throughout Berkshire Ecoregions. A summary extracted from *The Vascular Plants of Massachusetts: a County Checklist* (Sorrie and Somers, 1999) and the MIPAG report (MIPAG. 2005) describes the presence of some of the common invasive plant species in the counties of the Berkshire Ecoregions is provided in **Appendix VIII**, along with some additional references on invasive plants.

In some cases, non-native, invasive plant species have become established in forests and natural areas that are reasonably distant from fields, disturbed forest or forest edge. The establishment of non-native plant populations in the absence of disturbance is a source of concern (Bertin et al., in press). One specific population of an invasive plant population was identified as a threat to the successful establishment of a Watch Listed plant population in the apparent absence of disturbance (birds were the likely seed dispersers). The non-native plant population was mechanically removed from the site because the establishment of an aggressive non-native plant population on the unique site represented a threat to the biological diversity of the site. Norway maple (*Acer Platanoides*) represents another example of a plant that successfully becomes established in the understory of undisturbed forests more than 100 meters from a possible seed source (Bertin et al. in press).

More often non-native invasive plant species become established within fields and disturbed forest edges and then penetrate into undisturbed or minimally disturbed private and public forests. For example, Japanese barberry (*Berberis thunbergii*) and Glossy buckthorn (*Rhamnus frangula*) are among the common non-native invasive plants that can be found within DCR and DFW fields and forests throughout the state. Across the state glossy buckthorn is found in mature forest, at the Minuteman Battlefield in Lexington, throughout the Whately Wildlife Management Area in Whately and within Kampoosa Fen in Stockbridge.

Non-native invasive plants can be removed by a variety of techniques including manual, mechanical and chemical methods, however, long-term, permanent solutions require a plan to continuously monitor, remove and control new invasions. Early detection and removal are instrumental steps to controlling invasive plants. The choice of an acceptable technique will depend upon the landowner's resources, landowner's philosophy, as well as the inherent characteristics of the invasive plant population that needs to be removed. Sources of native plant stock exist (some commercial growers supply native species) and can be used to replace non-native invasive plants. For example, where retention of shrubs are desired to meet wildlife, aesthetic and other landowner goals, high bush blueberry, shadbush, dogwood and viburnum varieties are available and can be used to replace yard and field populations of Barberry, Honeysuckle or Burning-Bush. The New England Wildflower Society's established nurseries, with on-line native plant lists and catalogs, provide an extensive selection of native trees, shrubs, ferns and wildflowers. NEWFS is in the early stages of developing a large-scale native plant nursery at Nasami Farm, in the community of Whately (see www.newfs.org).

Special Places and Habitats

Many special "places" and "habitats" occur in the Berkshire Ecoregions. They are listed and / or described below:

Natural Communities

The Berkshire Ecoregions contain some of the most uncommon natural communities occurring in Massachusetts. Because of the presence of marble bedrock, local chemistry, particularly in the Marble Valley Land types, is different from most of the state. Marble (or limestone) outcrops support Calcareous Rocky Summit, Calcareous Cliff and Calcareous Talus Forest community types, and add nutrient richness to surrounding areas supporting uncommon Rich, Mesic Forests, along with other forest types. Surface and ground water near calcium rich bedrock contains more calcium than found in most of the rest of the state, supporting a variety of different types of wetland communities. The lowlands support globally uncommon calcareous fens, calcareous seepage marshes, and forested calcareous swamps, along with calcareous (hardwater) ponds, providing habitat for very different plant and animal species than most areas of New England. Many of these specialist species are rare, state listed to protect their small numbers of occurrences. Bog turtles are also federally protected. Data on rare habitat and species locations in the Berkshire Ecoregions is continually being expanded and updated.

Aside from the special habitats determined by water and soil chemistry, the Berkshire Ecoregions have good examples of uncommon floodplain communities in the lowlands, as well as uncommon types of communities in the higher elevations. The Berkshires have more high elevation areas than the rest of the state, and areas with higher elevation. These support natural communities, such as Hemlock-Hardwood Swamps, High Energy Riverbanks, and streams in the higher gradients that provide distinct habitat for different species. The rugged topography supports a mix of community-types that support species and natural communities generally found further north, for example High Elevation Spruce-Fir Forests are uncommon elsewhere in Massachusetts. Several types of Ridgetop communities, Ridgetop Pitch Pine- Scrub Oak Communities, for example provide a diversity of habitat within the prevailing forest.

The Berkshire Ecoregions area also have excellent examples of the more common types of matrix (prevailing) forest, including examples of both Old Growth and old but disturbed, “Older Forest” or “1830s forest” – areas that have been cut but never tilled.

During the past several years a team of scientists with the Department of Natural Resources Conservation at the University of Massachusetts (Amherst) et al have pioneered the development of a method [[*Conservation Assessment and Prioritization System \(CAPS\)*](#)] for quantitatively evaluating the ecological integrity of a landscape and its biodiversity⁷ value at any scale--state, region, watershed, town, etc. This method is a community-based, coarse-filter approach for assessing the ecological integrity of lands and waters and subsequently identifying and prioritizing lands for biodiversity conservation. The Phase I, Final Report was completed on June 9, 2005 and will soon be available on the Highlands Communities Initiative web site (see: “Last Great Places” section below for HCI web site). Such models can provide valuable information to assist with the prioritization and conservation of biodiversity value that will be incorporated into future land protection and management planning.

Old Growth

Old Growth, or never cut, forest, with advanced natural process characteristics is very uncommon in Massachusetts. Most of the acreage of Old Growth forest remaining in Massachusetts, totaling less than 1,200-acres statewide, is found mostly in the Berkshire Ecoregions. The identification, study, and documentation of these ancient forest remnants is principally the province of Friends of Mohawk Trail State Forest, working under special permit from the Department of Conservation and Recreation, and of researchers at Harvard Forest. For the Berkshire Ecoregions, Friends and Harvard Forest have mapped in those areas at approximately 913 acres, which occur almost entirely in difficult to access areas such as boulder fields and on steep slopes. Much of the Old Growth forest represents fairly common types of forest, but with a more complete complement of herbaceous and invertebrate species, undisturbed soils, and a stronger genetic base, than found in repeatedly disturbed forests. Trees up to 500 years in age have been confirmed. These areas of old growth are the least disturbed of all lands in Massachusetts, and are considered to be reference sites and potential sources of biodiversity for surrounding lands. Areas identified as Old Growth forest are planned to be cores of forest Reserves, protecting them and their constituent species and genetics. Another category of older forest that has been disturbed but not tilled contain valuable aspects of biodiversity, the so-called 1830 forests, is discussed under section IV. Forest Conditions, Health, and Productivity: [Historical Trends in Forest Composition](#). These 1830 forests can be considered as special heritage forests that provide us with future old growth reserves and often contain some of our most impressive trees as documented by the Friends of Mohawk Trail State Forest and the Eastern Native Tree Society for DCR. A summary table of the information above on old

⁷For our purposes, we define biodiversity as the diversity of life at all levels of organization from the gene to the landscape and all the ecological and evolutionary processes and interconnections that support life across levels of organization. In its broadest sense, biodiversity is the variety of life forms and environments that support that life. Here, we adopt a more pragmatic focus on the maintenance of viable populations of all native species (from carnivores to soil bacteria) and ecological communities (hereafter simply referred to as “communities”) found in their natural places, distributed and functioning within their natural range of variability.

growth is provided in **Appendix IX**. Additional information on ongoing old growth research can be found on the “[Harvard Forest](#)” web site and an [Old Growth Policy](#) has been developed (under the former Department of Environmental Management, Division of Forests & Parks, Bureau of Forestry) and is applied to the management of DCR, Division of State Parks & Recreation properties.

Areas of Critical Environmental Concern (ACEC)

“The Areas of Critical Environmental Concern (ACEC) Program was established in 1975 when the Massachusetts State Legislature authorized and directed the Secretary of Environmental Affairs to identify and designate areas of critical environmental concern to the Commonwealth.” The Department of Conservation and Recreation (DCR) administers the ACEC Program (301 CMR 12.00) on behalf of the Secretary of the Executive Office of Environmental Affairs.

“Areas of Critical Environmental Concern (ACECs) are places in Massachusetts that receive special recognition because of the quality, uniqueness and significance of their natural and cultural resources. These areas are identified and nominated at the community level and are reviewed and designated by the state’s Secretary of Environmental Affairs. ACEC designation creates a framework for local and regional stewardship of critical resources and ecosystems.”

There are 4 ACECs (Hinsdale Flats, Kampoosa Bog Drainage Basin, Karner Brook Watershed, and Schenob Brook Drainage Basin) in the Berkshire Ecoregions. They range in size from 1,350 acres to 14,500 acres. They all provide for the protection of related water resources, wetlands, natural communities, and rare & endangered species habitats.

[Hinsdale Flats Watershed:](#)

Designation Date: 1/31/92
Total Approximate Acreage: 14,500 acres
Watershed(s): Housatonic and Westfield
Municipalities: Dalton, Hinsdale, Peru, and Washington

[Kampoosa Bog Drainage Basin:](#)

Designation Date: 8/10/95
Total Approximate Acreage: 1,350
Watershed(s): Housatonic
Municipalities: Lee, Stockbridge

[Karner Brook Watershed:](#)

Designation Date: 7/17/92
Total Approximate Acreage: 7000 acres
Watershed(s): Hudson and Housatonic
Municipalities: Egremont and Mount Washington

[Schenob Brook Drainage Basin:](#)

Designation Date: 8/10/90
Total Approximate Acreage: 13,750 acres
Watershed(s): Hudson and Housatonic
Municipalities: Mount Washington and Sheffield

An ACEC Regulatory Summary is available at: www.mass.gov/dcr/stewardship/acec/regsum.htm ...

Additional information on the ACEC program is available at:
www.mass.gov/dcr/stewardship/acec/index.htm

Last Great Places

The *Berkshire Taconic Landscape* is considered by TNC, "...one of the most significant natural areas in the United States, and was selected as a conservation priority due to its health and biodiversity". It has a large, healthy, diverse, and unfragmented contiguous block of forest matched by few in southern New England. The landscape is interlaced with a network of underground water and high-energy streams that supplies alkaline or "sweet" water to some of the highest quality calcareous wetlands in the world in the landscapes valleys. This landscape is also known for its exceptionally pristine drinking water, and one of the highest concentrations of rare and endangered species (150) in New England. Additional information is available at: www.lastgreatplaces.org/berkshire/index.html.

Highland Communities Initiative

The *Highland Communities Initiative* is administered by the "Trustees of Reservations" and is composed of a 38 *community region* in the Berkshires (hci.thetrustees.org/pages/2648_statistical_profiles.cfm) intended to *promote land conservation and community preservation* in rural western Massachusetts. Additional information is available at: hci.thetrustees.org/

Finally, there are a number of **DCR properties (State Forests, Parks, and Reservations)** and **DFW properties (Wildlife Management Areas)** in the Berkshire Ecoregions, which provide a variety of habitats and outdoor recreation opportunities. The properties are listed by community, name, and acres in **Appendix X and XI** respectively. Also, see section **VII Socio-Economic Factors, Outdoor Recreation** and **Figures 31 & 32**.